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THE RELATIONSHIP BETWEEN SCHOOL VIOLENCE AND STUDENT PROFICIENCY

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Abstract

School violence has recently become a central concern among teachers, students, students' parents and policymakers. Violence can induce behaviors on educational agents that go against the goals of improving the quality of education and increasing school attendance. In fact, there is evidence that school environmental characteristics and student performance and behavior at school are related. Although school violence may have a direct impact on students' performance, such impact has not yet been quantified. In this paper, we investigate this issue using Brazilian data and show that, on average, students who attended more violent schools had worse proficiency on a centralized test carried out by the Brazilian Ministry of Education, even when we controlled for school, class, teachers and student characteristics. We also show that school violence affects more the students from the bottom of the proficiency distribution. Furthermore, we find out that besides the direct effect on student proficiency, it seems that school violence has an indirect effect on it operating through teacher turnover. Indeed, we show that the occurrence of violent episodes in a school decreases the probability of a class in that school having only one teacher during the academic year, and increases the probability of that class having more than one teacher (teacher turnover).

Keywords

School violence, student proficiency, teacher turnover

1. Introduction

Recently, teachers, students, students' parents and policymakers have been extremely worried about school violence. This concern is fair, since violence can induce some kinds of behavior on educational agents, which go against the goals of improving the quality of education and increasing school attendance. In fact, there is psychological evidence that school environmental characteristics and student performance and behavior at school are very related (Haller, 1992; Fowler and Walberg, 1991; Pittman and Haughwout, 1987), and that exposure to violence in the neighborhood and emotional and behavioral outcomes in children and youth are closely connected (Bowen and Bowen, 1999; Sampson, Raudenbush, and Earls, 1997; Berton and Stabb, 1996; Bowen and Chapman, 1996; Hill, Levermore, Twaite, and Jones, 1996; Cooley-Quille, Turner, and Beidel, 1995; Richters and Martinez, 1993). On the one hand, the lack of safety in schools sometimes obliges principals and teachers to reduce the requirements in the educational process. On the other hand, students can have difficulty concentrating during classes and eventually quit school. Indeed, a survey carried out by UNESCO in 2000 in fourteen Brazilian capitals showed that nearly half of teachers lose their motivation to work due to school violence, one third of them diminishes the rigorousness with which they lead their pedagogical activities, one fourth has difficulty concentrating and show unwillingness to work, and one fifth responds to the threats and/or violent events by asking to get transferred to another school, thus generating teacher turnover. Furthermore, roughly half of the students have concentration problems because of violence within and around schools, one third of them feels nervousness in face of violent acts and, finally, one third reacts with unwillingness to go to school.

Although school violence directly affects human capital accumulation, its effects on student performance has almost not been studied. Neither the literature on educational production function nor the literature on the economic consequences of crime have mentioned the effects of school violence on student achievement. The main reason is the lack of data. Grogger (1997) was the pioneer in analyzing the effects of school violence on economic outcomes. This author showed that that violence had important effects: moderate levels of violence reduced the likelihood of high school graduation by 5.1 percent and diminished the probability that a student would attend college by 6.9 percent. Lazear (2001) studied this issue theoretically and showed that the presence of disruptive students in a classroom could reduce the performance of their peers. Figlio (2005) and Kinsler (2006) found evidence supporting Lazear's conclusion using datasets with information on the individual student behavior.

In this paper, we take advantage of the SAEB 2003, a unique dataset provided by the Brazilian Ministry of Education which contains indicators of violence within and around schools and educational variables, to give evidence of the direct relationship between school violence and student proficiency and of the indirect relation between them, which seems to operate through teacher turnover. We follow Grogger's strategy for measuring violence with aggregate indicators. Nevertheless, while that author analyzes the impact of school violence on educational attainment (quantity of education), we investigate the effect of such violence on student proficiency (quality of education). We therefore intend to contribute to the understanding of school violence and to the formulation of public policies.

Our main results indicate that students who attend more violent schools usually have a worse performance on proficiency tests, even when the attributes of students, classes, teachers and schools were controlled for. We also find evidence that violence affects more students at the lower tail of the proficiency distribution. Besides the direct relationship between school violence and proficiency, there seems to be an indirect association between these variables operating through increase in teacher turnover. For all these results, one should emphasize the deleterious effect of the presence of drugs at schools: drug dealing and/or consumption seems to undermine the motivation of both students and teachers.

This paper is structured as follows. In the next section, we describe the database and the main characteristics of our sample, especially concerning school violence. In Section 3, we explain our empirical strategy: how we construct our variables of interest and what our econometric model looks like. In Section 4, we present our results and, finally, we conclude in Section 5.

2. Data

2.1. Database and sample

The data used in this study were obtained from the National Basic Education Evaluation System (SAEB), conducted by the National Institute of Educational Studies and Research Anísio Teixeira, accredited with the Brazilian Ministry of Education (INEP/MEC). SAEB collects information about students, teachers and school principals from a sample of public and private Brazilian schools every two years. Each selected student does a test – either on Portuguese or on Mathematics –, and answers a questionnaire about his/her study habits and his/her sociocultural background. Teachers and school principals participate by filling out

questionnaires about their profiles and their teaching practices, about management mechanisms and about the school's infrastructure.

Even though there are available data since 1995, in the present paper, we use only the 2003 database, because it was the first one that contained information on school violence. In addition, we work only with public schools as violence episodes tend to occur more often in public schools, as shown in Table 1 by the difference of means tests for indicators of violence in public and private schools. In that table, each indicator shows the occurrence (1) or not (0) of a violent event at a given school during the academic year. Indicators of attempt on life, theft, robbery and physical assault consider both students and teachers as victims, as we believe an unsafe environment that produces distorted incentives is a result of violent actions, irrespectively of the victim. The indicator of presence of weapons considers the concealed carry of firearms and/or of stabbing weapons (knives, pocket knives, stylets, etc.) by school members. Finally, the indicators of presence of drugs (consumption and/or dealing) and gang attacks consider these events both in and out of the school environment due to the underreporting of violence, as explained in the subsequent section.[1]

SAEB provides information about fourth graders in elementary school, eighth graders in middle schools, and senior high school students. However, we focus our analysis on students of these two latter grades because we believe that the age range of them is the most susceptible to violent behaviors. In fact, according to the report issued by Rezende and Tafner (2005) young individuals are overrepresented among victims and offenders. In 2003, for instance, youngsters aged 15 to 24 years accounted for 39% of homicide victims in Brazil, according to the Ministry of Health database (also known as DATASUS).

Table 1: Difference of means of school violence indicators

Variable	Mean		Test	
	Public schools	Private schools	Difference	EP
Attempt on life	0.0631	0.0104	0.0527***	0.0045
Theft	0.2928	0.1945	0.0983***	0.0113
Robbery	0.0285	0.0177	0.0108***	0.0039
Physical assault	0.3010	0.1440	0.1570***	0.0106
Presence of weapons	0.2143	0.0578	0.1565***	0.0083
Presence of drugs	0.4573	0.2737	0.1836***	0.0126
Gang attacks	0.1841	0.0814	0.1027***	0.0085

Source: SAEB 2003.
***significant at 1% **significant at 5% *significant at 10%

[1] See details on the construction of these indicators in the Appendix.

After the exclusions described above, our sample of interest consists of nearly 80,000 students, 6,000 teachers, 3,000 school groups and 1,800 schools. For our estimates, one should recall that observations with missing data were excluded. The original SAEB 2003 sample consists of approximately 220,000 students, 17,000 teachers and 6,000 schools.

2.2. Descriptive statistics of school violence

The main concerns with violence noticed by Brazilian schools in 2003 were presence of drugs, physical assault, theft, carry of arms by school members and gang attacks, in this strict order (Table 1). Attempts on life, despite the small number of schools that reported such problem, are also significant owing to the severity of episodes.

Nevertheless, one should bear in mind that indicators of school violence –our main variables of interest – are reported by school principals. Therefore, there are two limitations: planning of answers and subjective perception and notification of violence. The first limitation was established by Grogger (1997). He emphasizes that, on the one hand, school principals can answer questions strategically, by giving answers that explain students' low performance, thus causing the effects of violence to be overestimated. On the other hand, school principals might not want to reveal the actual level of violence in their schools so that they are not seen as incompetent, causing the effects of violence to be underestimated.

In a recent analysis of the survey into school violence in Brazil, Sposito (2001) affirms that the reports of violence by Brazilian schools vary considerably, depending on the predominant behavior observed in the public education system. She mentions that sometimes the notification of violent actions shows the probable weaknesses in pedagogical work, and that sometimes notification may yield additional gains to the schools, such as larger material and human resources or some wage benefits to the teachers that work in risky areas. Since we did not observe the predominant behavior in public schools, we cannot categorically state how measurement error in violence indicators behaves and how this influences our estimates. However, three violence indicators from the SAEB questionnaire are reported separately for school premises and for schools' neighboring areas and, therefore, the significant difference in these indicators may provide evidence of notification problems. Table 2 seems to indicate that school principals are reporting less violence within school premises than actually there is.

Table 2: Violence indicators for public schools

Violence indicator	Within school	Around school	Difference	SE
Consumption of drugs	0.0514	0.2460	-0.1946***	0.0105
Drug dealing	0.0282	0.1780	-0.1498***	0.0091
Gang attacks	0.0293	0.0761	-0.0468***	0.0068

Source: SAEB 2003.
***significant at 1% **significant at 5% *significant at 10%

Because of that finding, our indicators of presence of drugs (consumption and/or dealing) and gang attacks at schools contemplate these events both within and around schools. In fact, it seems unreasonable that 25% of schools have drug consumption in their surroundings and that only 5% of them have drug consumption within their premises.

Table 3: Violence indicators in Brazil per state – 2003[†]

State	Homicide rate	Attempt on life	Theft	Robbery	Physical assault	Weapons	Drugs	Gang attacks
Acre	24.48	0.14	0.49	0.01	0.37	0.45	0.57	0.32
Alagoas	35.61	0.03	0.15	0.01	0.11	0.13	0.30	0.12
Amapá	34.59	0.23	0.46	0.07	0.47	0.52	0.43	0.30
Amazonas	18.41	0.13	0.51	0.03	0.29	0.27	0.60	0.20
Bahia	16.11	0.02	0.17	0.02	0.27	0.15	0.31	0.09
Ceará	20.13	0.07	0.17	0.01	0.27	0.20	0.32	0.08
Distrito Federal	33.88	0.28	0.63	0.05	0.50	0.50	0.77	0.41
Espírito Santo	50.12	0.14	0.49	0.09	0.36	0.18	0.54	0.12
Goiás	25.37	0.16	0.32	0.02	0.39	0.28	0.56	0.25
Maranhão	13.48	0.02	0.08	0.01	0.10	0.18	0.42	0.17
Mato Grosso	34.25	0.13	0.34	0.03	0.31	0.24	0.50	0.24
Mato Grosso do Sul	32.49	0.09	0.42	0.03	0.31	0.40	0.55	0.27
Minas Gerais	20.83	0.07	0.26	0.04	0.28	0.29	0.46	0.27
Pará	21.35	0.08	0.34	0.02	0.25	0.18	0.48	0.20
Paraíba	17.48	0.06	0.20	0.05	0.17	0.14	0.42	0.11
Paraná	25.55	0.06	0.34	0.03	0.33	0.26	0.51	0.23
Pernambuco	55.34	0.03	0.14	0.04	0.29	0.20	0.38	0.15
Piauí	10.19	0.05	0.16	0.01	0.12	0.09	0.24	0.10
Rio de Janeiro	52.55	0.03	0.26	0.03	0.26	0.06	0.37	0.08
Rio Grande do Norte	14.02	0.04	0.30	0.05	0.29	0.23	0.44	0.15
Rio Grande do Sul	18.13	0.06	0.46	0.03	0.37	0.27	0.50	0.21
Rondônia	38.88	0.17	0.44	0.03	0.34	0.42	0.49	0.24
Roraima	29.67	0.10	0.50	0.00	0.39	0.33	0.63	0.23
Santa Catarina	11.79	0.05	0.48	0.02	0.37	0.32	0.57	0.28
São Paulo	35.91	0.05	0.39	0.04	0.45	0.19	0.62	0.23
Sergipe	25.02	0.13	0.20	0.06	0.25	0.15	0.46	0.12
Tocantins	16.50	0.08	0.12	0.01	0.20	0.13	0.42	0.13
Brasil	**28.86**	**0.06**	**0.29**	**0.03**	**0.30**	**0.21**	**0.46**	**0.18**

Sources: DATASUS and SAEB – 2003.
[†] The homicide rate in the first column was obtained from DATASUS and the violence indicators in the other columns take into account all public schools surveyed by SAEB.

The second limitation of violence indicators reported by school principals – the matter of subjectivity – arises from the design of the SAEB questionnaire itself. School principals must answer whether a given violent episode occurred or not in their schools during the academic year. Some events are remarkable and therefore a case for notification (e.g.: attempts on life). On the other hand, some other events rely on the perception of violence by the school principal or on his/her involvement in the school community, as in cases of physical assault and presence of drug use and/or dealing within or near schools.

On account of this scenario, it is quite understandable that there is difference in the violence indicators obtained by SAEB as opposed to those provided by other sources. In fact, while the states of Pernambuco and Rio de Janeiro, for instance, have a higher rate of homicide victims per 100,000 inhabitants, according to DATASUS data, these are the states with the lowest number of public schools that report on the presence of drugs within their premises or in their surroundings (Table 3). The states of Santa Catarina and Rio Grande do Sul, however, have very low homicide rates, but a quite large number of public schools that report on violence compared to other Brazilian states, as also shown in Table 3. These examples show how subjective indicators are. In the first situation, it is as if violence were an integral part of people's daily lives and thus its evidence goes unnoticed by school principals. In the second situation, however, we perceive school principals give better attention to violent episodes, perhaps due to the lack of safety indicated by uncommon events.

Even though the violence indicators reported by school principals do not accurately measure the dimension of this problem in Brazilian schools, they show the sensitivity of such schools to the problem. Therefore, our aim is to assess the relationship between violence perception and school outcomes, since sensitivity to violent events causes changes in students' behavior and consequently affects their performance in school.

3. Empirical Methodology

The aim of this study is to assess how violence in schools affects the proficiency of students. Thus, the dependent variable is the student's performance in Mathematics or in Portuguese, depending on the subject he or she was evaluated in, and the regressors of interest are violence indicators or variables that possibly increase or reduce the correlation with it: teacher's qualification, differences between teacher and student in terms of sex and race, number of students in class, percentage of boys, percentage of non-white students, lag between age and grade in class, and percentage of students with a poor family background.

Obviously, we controlled for several characteristics regarding students, teachers, classes and schools. The descriptive statistics of all variables used are shown in Table A1 in the Appendix.

In what follows, we describe how we built the variables of interest and we explain why we included them. First, we built a *school violence index*, our major variable in this study. For simplification, we just added the several violence indicators.[2] As each indicator assumes value zero or one and we have seven indicators, our index ranges between zero and seven, where zero represents the lowest level and seven stands for the highest level of school violence. Note also that teacher's qualification was represented by three indicators: college education, graduate education, and experience (if he or she has more or less than 10 years of experience). We included these variables to capture the direct positive effects of teacher's qualification and to investigate whether more qualified teachers manage to reduce the negative correlation of violence with proficiency, either by means of implementing innovative pedagogical projects or by approaching and dealing with violence problems at school.

The *difference between teacher and students'* characteristics was represented by two indicators: sex difference and racial difference. Each indicator assumes value one when any difference exists and value zero, otherwise. We included these variables for two reasons: (i) to check whether the difference in these dimensions causes detachment between teacher and student, compromises student learning and consequently, worsens student proficiency, as demonstrated in the literature,[3] and (ii) to assess whether this difference increases the negative correlation of violence, since it may trigger conflicts between the parties involved.

The *number of students in class* on the day of the SAEB[4] survey was included in order to contemplate the widely investigated effect of class size[5] and to check whether a larger number of students in class increase the negative correlation of violence with proficiency due to the probable formation of rival subgroups and occasional conflicts between them.

The *percentage of boys in class* was included for two reasons: (i) to assess the direct effects of male students on the individual proficiency of students, as boys often show poorer interest and disrupt the class environment more often, and (ii) to check whether the presence

[2] Alternatively, we have also constructed an indicator that is a weighted average of school violence indicators, where the weights were chosen based on principal component analysis. However, results tended to be quite similar to those based on the simple sum of indicators.

[3] For further details, see Ehrenberg, Goldhaber and Brewer (1995), Ferguson (1998) and Dee (2004, 2005).

[4] Class size is measured in two different ways: the amount of students on the roll call and the number of students that attended class on the day of the SAEB survey. We used the second one because it contemplates possible changes in class size throughout the year, which arise from enrollment or dropout. Nevertheless, we are aware of the problem regarding school absenteeism, which may be included in this measure.

[5] For further details, see Angrist and Lavy (1999), Hoxby (2000) and Krueger (2003).

of more boys in class increases the negative effect of violence on proficiency due to the fact that male individuals seem to be more aggressive. Actually, if we raise the rather strong hypothesis that the characteristics of homicide victims represent those of murderers themselves, we have the following violence pattern, according to DATASUS data: 93.62% of the homicide victims aged between 15 and 24 years, in 2003, were male. The *percentage of non-white students in class*, however, was taken into consideration (i) to check whether the racial composition of class has a direct effect on the individual proficiency of students, as highlighted by the literature on social interaction,[6] and (ii) to investigate whether this percentage increases the negative effects of violence on student performance, since the social stereotype produced by interracial prejudice can trigger conflicts in the classroom.

We also included the *percentage of repeaters in class*. Our goals were (i) to tackle the deterioration in student performance caused by the lag between age and grade in the classroom, as pointed out by the literature,[7] and (ii) to check whether classes consisting of different-aged students (repeaters are older for obvious reasons) increase the negative correlation of violence with proficiency due to conflicts that could arise from different interests.

Finally, we included the *percentage of students with a poor family background*, represented by two variables: the percentage of students who benefit from the study allowance granted by the government (cash transfer program called "Bolsa-Escola"), and the percentage of working students. We included these variables (i) to investigate whether the socioeconomic level of students influences their individual performance, as suggested by the literature on social interactions[8], and (ii) to check whether the sociocultural distance of the class from the syllabuses taught in schools increases the negative correlation of violence due to the conflicts of interest that might arise in this situation. In fact, Brazilian schools often prioritize encyclopedic syllabuses in the educational process that are not directly applicable to the work environment, and quite often, too far from students' everyday life.

As our goal is to show the association between school violence and student proficiency and as some regressors of interest interact with violence, we estimated the following equation:

$$(1) \quad \ln(Y_{ics}) = X'_{ics}.\alpha + \beta.V_s + I'_{ics}.\gamma + \delta.(V_s * I_{ics}) + \varepsilon_{ics}$$

[6] See, for instance, Card and Rothstein (2007), for recent evidence.
[7] See, for instance, Ferrão, Beltrão and Santos (2002) and Machado (2005).
[8] See, for instance, Card and Rothstein (2007).

where $\ln(Y_{ics})$ is the logarithm for the proficiency of student i, of class c and of school s; X_{ics} represents all the control variables: characteristics of students, teachers, groups and schools; V_s is the index of school violence; and I_{ics} stands for all regressors described above: teacher's qualification, teacher-student differences in terms of sex and race, number of students in the group, percentage of boys, percentage of non-white students, lag between age and grade in the class, and percentage of students with a poor family background. Since our objective was to check how each explanatory variable is related to student proficiency, both in the mean and in certain quantiles of proficiency distribution, we estimated the coefficients of equation (1) using linear regressions and quantile regressions. The coefficients of greater interest are β, γ and δ. Each coefficient of δ measures the impact of a regressor of interest on the correlation of school violence with student proficiency.

If we restrict the coefficients of interactions to zero and if β is negative, then students from schools with higher violence rates or from more violent neighborhoods show worse proficiency. By letting coefficients δ free, if β decreases in absolute values or becomes nonsignificant and some coefficient of interaction is significant and positive, then that variable that interacts with violence reduces the negative correlation between violence and proficiency. Suppose that the variable of interaction is teacher's qualification. Thus, coefficient δ measures the impact of a qualified teacher on the correlation of school violence with student proficiency. If the coefficient of this interaction is positive and significant, then better qualified teachers are able to implement teaching projects that minimize the negative correlation between violence and proficiency. On the other hand, if β increases in absolute values and some coefficient of interaction is significant and negative, then that variable which interacts with violence enhances the negative correlation between violence and proficiency. Consider, for instance, the interaction of the number of students in a class with violence. If the coefficient of this interaction is negative and significant, then the deleterious effects of violence are bigger in larger classes, enhancing the negative correlation.

However, one should highlight that the coefficient of the violence rate must be interpreted with caution. Actually, there might be an endogeneity problem between school violence and student proficiency that could arise through the simultaneity of relations and/or through the omission of relevant variables. The simultaneous relationship can occur when school violence hinders achievement, as pointed out by the survey conducted by UNESCO, and at the

same time, the worst performance stimulates violent actions in the school environment. The rationale for the latter argument is as follows: students with poor school performance tend to have fewer opportunities in the job market; consequently, they feel more encouraged to engage in criminal acts and, therefore, performing violent actions at school is just one more criminal behavior.

With regard to the omission of relevant variables, one should recall that the admission of students to a school is a non-random family decision process, and that the maintenance of students in school depends on how attractive the school is. Parents who are more concerned with the education and safety of their children may prefer to enroll them in better and safer schools, despite the higher fees,[9] and can participate more actively in school management. Furthermore, safer schools with better teaching quality tend to attract and maintain highly motivated students. Nevertheless, we should note that students who do mind about violence and who cannot attend these schools wind up quitting. This makes the worst schools, with higher violence rates and poorer teaching quality, concentrate the least diligent students and those who are less sensitive to violence. In econometric terms, parent's preference for better teaching quality and for safer schools and the attraction of best students to safer schools bring about an endogeneity problem, because this affects both school violence indicators and student proficiency. In other words, better and safer schools tend to concentrate students with higher proficiency and better violence indicators. This eventually overestimates the negative correlation between violence and proficiency. Nonetheless, the dropout of students from the most violent schools, who are more sensitive to violence, tends to minimize the correlation between violence and proficiency. Because there seems to be more factors in favor of the concentration of more proficient students in safer and more attractive schools, we believe overestimation must be a predominant feature.

Even though we do not manage to deal with the simultaneity problem, we have sought to ease the problem with omitted variables by including five SAEB 2003 variables that may be used as proxies for school management, parent's participation in this process and in the school life of their children, and school attractiveness. The variables are the following: number of times the school board meets during the year,[10] presence of fences or a wall around the school, average level of education of students' mothers at a given school, percentage of households with electrical power supply, and percentage of students of a group that miss on

[9] At first, this argument seems inappropriate for public schools, but we may think, for instance, of the cost of attending a school that is located farther away.

[10] Inexistence of a school board was considered together with the category entitled "existence of a school board, but no meeting during the academic year."

the day of tests. The frequency of school board meetings demonstrates the quality of school management: the more the school board members – principals, teachers and parents – meet to discuss and try to solve the problems faced by the school, the better the parent's follow-up of the teaching-learning process will be and the more efficiently resources will be allocated. As a matter of fact, the presence of fences or a wall around the school may reflect parent's pressure for investments in safety. The mothers' educational background denotes the participation of mothers in decisions at the school level and in the follow-up of the school life of their children: we believe better educated mothers tend to be more demanding in parent's meetings, for instance. The percentage of households with electrical power supply reflects the level of social commitment of the community to which the student belongs: the more pressure for public services is brought to bear by the community, the more comprehensive and the better the services will be. According to the spillover effect, local schools are expected to come under this social pressure. Finally, the percentage of students who fail to attend school on the day of SAEB test indicates how unattractive the school is. Schools with the worst teaching quality and with little concern about the academic follow-up of students are expected to suffer more terribly from dropout and/or school absenteeism. By including these variables, we hope the correlation between violence and proficiency will have a closer effect to the real effect of violence on schools.

Besides showing the association between school violence and student proficiency, we also want to demonstrate the relationship between school violence and teacher turnover. That is, we want to show that not only does school violence has a direct effect, but that it is also indirectly associated with student performance as a result of teacher turnover. By the way, a study undertaken by UNESCO in 2000 clearly revealed that one of the possible consequences of school violence on the quality of teaching arises from teacher turnover (Abramovay and Rua, 2004). As teachers seek to get transferred to safe schools, there are job openings at the most violent schools, which consequently lead to detrimental discontinuity of the teaching-learning process. This results in worse student performance.

Since the number of teachers a given class has had throughout the year (variable included in the database) is a potential proxy for turnover, then we can estimate how our violence variables are related to this number. It should be highlighted that, although the distribution of this variable across public and private schools is quite similar, we use only information on public schools. Only in them we can associate the number of teachers throughout the academic year with turnover, as only in these schools does only one teacher teaches the whole syllabus of a discipline. At private schools, a subject is often taught by

more than one teacher: one example is Portuguese, which can be taught by three teachers – one who teaches grammar, one who teaches literature and one who teaches writing. After these remarks, we built a dependent variable categorized as follows:

– 0, if the class did not have a teacher during the academic year;
– 1, if the class had only one teacher during the academic year (normal circumstance); and
– 2, if the class had more than one teacher during the academic year (turnover).

We used the multinomial logistic model to estimate how violence indicators are associated with the probability of a class having no teacher, one teacher, or two or more than two teachers during the academic year. Again, we controlled for the characteristics of the class and of the school, as shown in Table A2 in the Appendix. The probabilities in the multinomial logistic model are outlined below:

$$(2)\ P_0(x) = \frac{1}{1 + \sum_{j=1,2} e^{(\beta_j' x)}}, \quad P_1(x) = \frac{e^{(\beta_d' x)}}{1 + \sum_{j=1,2} e^{(\beta_j' x)}} \quad \text{and} \quad P_2(x) = \frac{e^{(\beta_i' x)}}{1 + \sum_{j=1,2} e^{(\beta_j' x)}}$$

We calculated the impact of marginal changes in violence indicators on probabilities P_j. The marginal effects (percentage variations in the probability of an event occurring when a given independent variable is modified) are calculated based on the estimated coefficients $(\hat{\beta})$, as shown in what follows:

$$(3)\qquad \frac{\partial P_j}{\partial X_k}(x) = P_j(x)\left(\hat{\beta}_{j_k} - \sum_{j=1,2} P_j(x)\hat{\beta}_{j_k} \right) \qquad \forall j = 0, 1 \text{ and } 2$$

When the variable is discrete as, for example, a school violence indicator, the marginal effect measures the difference between the probability of violence having occurred or not at that school. On the other hand, when the regressor is continuous, the marginal effect measures to what extent the probability changes when this regressor has a variation equal to one.

4. Results

4.1. Direct relationship between violence and proficiency

In table 4, we provide the estimation results for equation (1) using the school violence indicator. We specified four models. In the first one, we controlled for the characteristics of students, teachers, classes and schools, but we did not deal with omitted variables. In the second one, we added variables that aimed to minimize this problem: the number of times that the school board met during the year, the presence of fences or walls around the school, the average level of maternal education at a given school, the proportion of students' households with electric power supply, and the percentage of students that missed class on the day of the test. In these two models, we did not include interactions of violence index. Our goal was to capture the correlation of violence without worrying about possible factors that could either mitigate or stimulate it. In the third model, we included interaction of the violence index with teacher's attributes. Here, we were interested in knowing whether the teacher-student difference and teacher's qualification influenced the correlation coefficient of school violence with student proficiency. Finally, in the fourth model, we excluded the interactions of the violence index with the teacher's attributes and included the teacher's interactions with class attributes. Our aim was to verify how the number of students and class configuration could enhance or minimize the correlation between violence and proficiency.

Table 4: School violence and student proficiency

Ln(proficiency)	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Teacher-student difference in terms of sex	-0.00571**	-0.00557**	-0.00481	-0.00550*
	(0.00284)	(0.00284)	(0.00502)	(0.00283)
Teacher-student difference in terms of race	-0.01523***	-0.01553***	-0.01465***	-0.01551***
	(0.00315)	(0.00314)	(0.00511)	(0.00314)
Teacher with college education	0.00805	0.00082	0.00615	0.00263
	(0.00771)	(0.00780)	(0.01206)	(0.00783)
Teacher with graduate degree	0.00954***	0.00827**	0.01083**	0.00767**
	(0.00329)	(0.00328)	(0.00548)	(0.00328)
Teacher with less than 10 years' experience	0.00082	0.00315	0.00385	0.00295
	(0.00329)	(0.00329)	(0.00549)	(0.00329)
Number of students in the class	0.00030	-0.00019	-0.00020	0.00059*
	(0.00021)	(0.00023)	(0.00023)	(0.00032)
Percentage of boys in the class	-0.00002	-0.00016	-0.00016	0.00023
	(0.00012)	(0.00012)	(0.00012)	(0.00019)
Percentage of non-whites in the class	-0.00104***	-0.00085***	-0.00085***	-0.00091***
	(0.00011)	(0.00011)	(0.00011)	(0.00014)
Percentage of repeaters in the class	-0.00035***	-0.00023**	-0.00023**	-0.00051***
	(0.00010)	(0.00010)	(0.00010)	(0.00016)
Percentage of students with "Bolsa-Escola"	-0.00027*	-0.00015	-0.00015	0.00012
	(0.00016)	(0.00016)	(0.00016)	(0.00021)
Percentage of working students	-0.00059***	-0.00042***	-0.00042***	-0.00024
	(0.00013)	(0.00013)	(0.00013)	(0.00016)
School violence index	-0.00526***	-0.00474***	-0.00095	0.00942*
	(0.00092)	(0.00092)	(0.00482)	(0.00502)
Interaction of violence index with :				
Difference in terms of sex			-0.00036	
			(0.00166)	
Difference in terms of race			-0.00030	
			(0.00168)	
College education			-0.00294	
			(0.00474)	
Graduate degree			-0.00099	
			(0.00176)	
Less than 10 years' experience			-0.00029	
			(0.00171)	
Number of students				-0.00031***
				(0.00011)
Percentage of boys				-0.00017***
				(0.00007)
Percentage of non-whites				0.00003
				(0.00004)
Percentage of repeaters				0.00010**
				(0.00004)
Percentage of students with "Bolsa-Escola"				-0.00010
				(0.00006)
Percentage of working students				-0.00007*
				(0.00004)
Correction for omitted variables	No	Yes	Yes	Yes
Number of observations	48,880	48,880	48,880	48,880
F(k-1, n-k)	146.62	140.13	131.08	129.48
Prob > F	0.0000	0.0000	0.0000	0.0000
R^2	0.27	0.27	0.27	0.27

As shown in Table 4, the main coefficient of interest – school violence – is negative and significant in the specifications estimated without the interactions. The coefficient shows us that, on average, the occurrence of an additional violent event at a given school is associated with a reduction of approximately 0.47% in student proficiency. Actually, before we correct the omitted variables problem, the coefficient was a bit higher (0.53%), supporting our assumption about the overestimation of the effect of school violence due to the concentration of the most proficient students at safer and more attractive schools.

At first, the correlation between school violence and student proficiency seems to be negligible. However, given that the index encompasses seven violence indicators, this means that the deterioration in proficiency between the least violent school and the most violent one corresponds to approximately 3.3%. Still, as the effects found in the literature of the impact of educational inputs on student performance are too small, violence seems to be relevant. This result is in line with the findings of the study conducted by UNESCO, showing that school violence contributes to worsening student performance. They also indicate that, apart from affecting the level of education, as pointed out by Grogger (1997), violence also undermines the quality of learning for those who stay in school.

It is interesting to examine which violence indicators have the most harmful effects on student performance in Brazilian public schools. Table 5 provides the coefficients for the estimation of the second specification (with correction for the omission of relevant variables) by replacing the violence rate with the indicators it comprises. By using these estimates and the descriptive statistics in Table 3, we show that the main problem at schools regarding violence is the presence of drug dealing and/or consumption in their premises. As a matter of fact, students who attend schools that face such problem tend to have a 1% lower proficiency, and nearly half of Brazilian schools have notified this problem, and in some states this accounts for 60% of schools, as is the case of São Paulo (see Table 3). Therefore, fighting off drug dealing at schools must be one of the major concerns of public policymakers. Another indicator that has a quite detrimental effect on student proficiency is the presence of weapons at schools, with a coefficient of -0.6%. As 21% of school principals report concealed carry of firearms and/or of stabbing weapons (knives, pocket knives, stylets, etc.) by school members, this is also alarming. So, policies targeted at disarming the population may have good effects on student learning, and may also deter homicides and other types of violence. Finally, we have the robbery indicator, whose coefficient is the highest (-1.4%). Nevertheless, as only 3% of Brazilian public schools have reported on this type of violence (3%), this seems to be a secondary concern.

Table 5: School violence indicators and student proficiency

Ln(proficiency)	Coefficient	SE
Attempt on life	-0.00620	0.00472
Theft	-0.00122	0.00335
Robbery	-0.01442**	0.00591
Physical assault	-0.00155	0.00344
Presence of weapons	-0.00629*	0.00347
Presence of drugs	-0.00929**	0.00362
Gang attacks	-0.00399	0.00363

Source: SAEB 2003.
Robust standard errors (SE).
***significant at 1% **significant at 5% *significant at 10%

It should be stressed that this negative correlation of violence with proficiency might reflect both the offending behavior of youths and their status of victims. We know that in the eighth grade of middle school several students make decisions about job opportunities: if they do not get a job in the conventional job market, they might indulge in illegal activities such as drug dealing, for instance. If they opt for this, they begin to act violently and, consequently, they start committing offenses even at school, compromising their learning and that of their peers. In an attempt to separate the aggressive status from that of victim in our estimates, we performed the same regressions for the fourth grade of elementary school. We believed that violent behavior would be less likely in this age group and therefore, if there was any harmful effect of violence, this would be that of victim. The coefficient for school violence in this school grade was absolutely lower than that found for the eighth grade and for the senior grade of high school, but it was positive, contrary to our expectations, and significant.[11] Despite the unexpected sign, this coefficient seems to indicate that there is no victim status in our estimates for the eighth grade and for the senior grade of high school: young people's aggressiveness and its spillover effect appear to determine our results, as in the model proposed by Lazear (2001).

When we interacted the violence index with teacher's attributes – teacher-student difference in terms of sex and race, college education, graduate education and experience –, none of the coefficients was statistically significant, as shown in Table 4. In other words, we did not find any evidence that sex or racial differences between teachers and students maximize the deleterious effect of violence, or that teacher's qualification might reduce the

[11] 0.00314, with standard error 0.00141: therefore, significant at 5%.

negative correlation between school violence and student proficiency. Moreover, the coefficient for the violence index was no longer significant.

Even though the correlations of the violence index with teachers' attributes are not significant, Table 4 shows that these attributes have direct effects on student performance. Students who attend classes taught by teachers with a graduate degree, for instance, have a 1% higher proficiency. The teacher-student differences in terms of sex and race, on the other hand, hamper student performance by 0.5% and 1.5%, respectively, being consistent with the evidence provided by Ehrenberg, Goldhaber and Brewer (1995), Ferguson (1998) and Dee (2004, 2005). The explanation for this phenomenon lies in what the literature denominates passive and active effects of a teacher. Passive effects arise from the simple identification between teacher and students resulting from their belonging to the same race, sex and/or socioeconomic background: they do not involve any kind of behavior on the part of the teacher. The presence of a teacher from a different race, for example, might influence students' expectations and motivations and hinder the healthy interaction between teacher and students that stimulates learning. At the same time, the relationship between a male teacher and a female student, for instance, might cause unease due to stereotypes and undermine teaching-learning interactions. In turn, active effects arise from different behaviors of teachers towards students of a different race, sex and/or socioeconomic background. Prejudice often leads teachers to segregate some students, interfering with the teaching-learning process. With regard to public policies, this means that the qualification of teachers from the same community to which students belong, for example, may be efficient in improving education.

When we correlated the school violence index with class size and class characteristics, in the fourth specification of Table 4,[12] we found strong evidence that the number of students in the classroom and the percentage of male students intensify the deleterious effect of violence, although the coefficients are not so important economically. Thus, evidence seemingly suggests that the larger the number of students in the classroom, the most likely the formation of subgroups and the existence of conflicts between them and, consequently, the stronger the correlation in absolute terms between violence and school performance. Another possible mechanism whereby the size of a classroom may potentiate the harmful effect of school violence on proficiency is the difficulty teachers have controlling very big groups. Regarding the role of the percentage of male students in the classroom in strengthening the negative correlation between violence and proficiency, recall the data provided by

[12] Note that we excluded the correlations of the violence index with teacher's attributes in this specification because they had not been significant in the previous specification.

DATASUS, according to which 93.62% of homicide victims aged 15 to 24 years, in 2003, were male. Assuming again that the characteristics of homicide victims reflect the attributes of murderers, perhaps a very plausible hypothesis, we can say that boys are more aggressive and therefore it is natural that the larger number of male students ends up enhancing the detrimental effect of violence.

Another remarkable correlation in the fourth specification in Table 4 concerns the school violence index with the percentage of working students. Despite its small economic importance, this percentage also seems to increase the deleterious effect of violence. A possible explanation to this fact is the existence of competing interests between working students and teachers with respect to the syllabuses taught in class. In general, workers want classes that are more closely linked to the working environment whereas teachers would rather teach more propaedeutical classes. Another explanation is the problem students have juggling studies and work: these students may show difficulty keeping up with the class due to their feeling tired and not being understood by their teachers. Both conflicts of interest may encourage discussions and fights at schools and, as a result, heighten the harmful effect of violence. The last significant interaction concerns the percentage of repeaters. However, the coefficient sign was different from that which we expected. We expected the number of repeaters in a class to be associated with greater disruptive behavior, as these students usually happen to be the most undisciplined, and consequently, this would increase the negative correlation between violence and proficiency. In fact, estimates indicate quite the contrary: they suggest that the percentage of repeaters lessens the effect of school violence. Maybe this is due to the experience these students acquire for having flunked, a hypothesis we regard as plausible but not so defensible. To conclude this analysis, the correlations of the school violence index with the percentage of non-whites and with the percentage of students who benefit from the study allowance granted by the government (“Bolsa-Escola”) were not statistically significant.

It is interesting to have a look at the close relationship between the characteristics of the class and students’ proficiency. Curiously enough, we did not find striking evidence for the widely documented class size effect, nor for the expected negative correlation between the percentage of male students and proficiency. Among the analyzed attributes, only the percentage of non-white students, of repeaters, and of working students yielded significant coefficients. Albeit economically nonsignificant, these negative coefficients suggest the presence of harmful peer effects arising from racial, educational and economic issues. The presence of many non-white students in a class may exert passive and active effects on

teachers, as we explained previously, causing educational losses to the whole class. On the other hand, the spillover effect of the percentage of repeaters can be justified by the low educational background of these students, by the fact that they are potentially more undisciplined and by the difficulty the teacher has in conducting a teaching project that meets the interests of students whose age differences are quite large. The peer effects arising from the percentage of working students can be explained by the conflict of interests between teachers and students. As we argued previously, working students prefer classes that are more closely related to their working environment whereas teachers often follow strictly propaedeutical teaching manuals. Furthermore, as these students juggle work and study as part of their daily routine, they might have some difficulty keeping up with classes and accomplishing the tasks requested by the teacher. This combination of factors results in rowdier and slower classes, which is eventually negative to the whole group.

Another characteristic of the class that deserves attention is the percentage of students who benefit from the study allowance granted by the government ("Bolsa-Escola"). Albeit weak, there is evidence that the presence of several of these students in a classroom may be detrimental to the performance of the group as a whole. A possible explanation to this fact is the conflict of interests between students who have just joined the schooling system and those who have already been attending school. As newcomers often do not understand the subject matter due to their poor background, the classes may have a slower pace and negatively affect the learning of other students. In this situation, make-up classes for students who benefit from the study allowance granted by the government may help circumvent the problem. Another plausible explanation refers to the violent reaction of students who have just entered school to the stigma they suffer because of their low socioeconomic background. As described by Sposito (2001), these stigmatized students may start to tease other students, obtruding themselves by instigating fear or physical force, turning the classroom into a less than adequate environment for learning.

All the results presented above are average. However, there may be heterogeneity in students' response to violence. Better motivated students tend to be less influenced by factors that negatively affect learning. In order to investigate these possible differences in the association between violence and student proficiency in the proficiency distribution, we carried out quantile regressions using a specification that includes all controls (attributes of students, teachers, schools and groups), including also the variables that try to make up for the omission of relevant variables, and the violence index. As shown in Table 6, violence seems to affect more negatively those students at the lower tail of the proficiency distribution.

Table 6: Impact of school violence on student proficiency in the proficiency distribution

Quantile (proficiency)	Coefficient	SE
0.05	-0.00577***	0.00201
0.10	-0.00497***	0.00149
0.25	-0.00464***	0.00095
0.50	-0.00526***	0.00083
0.75	-0.00408***	0.00083
0.90	-0.00354***	0.00086
0.95	-0.00409***	0.00100
OLS	-0.00474***	0.00092

Source: Saeb 2003.
Robust standard errors (SE).
***significant at 1% **significant at 5% *significant at 10%

In fact, the negative correlation of violence with proficiency decreases by approximately 29% when we move from the first to the last decile. This means that, in the first decile of the distribution, there is a proficiency difference of 3.5% when we compare the most violent school with the least violent one and, in the last decile, this difference drops to 2.5%. Thus, violence appears to increase the inequality observed in student performance.

4.2. Indirect relationship between violence and proficiency: teacher turnover

When we assessed the direct relationship between violence and student proficiency in the previous section, we included, in the regression, the average number of Portuguese and Math teachers that each eighth grade and senior grade of high school had throughout the school year. Our goal was to check whether there was some harmful effect of teacher turnover on student performance. Even though the coefficient turned out to be negative in the four specifications estimated, it was not statistically significant in either of them. Notwithstanding, we decided to investigate whether there existed some association between school violence and teacher turnover. If there were a negative correlation, then violence could also affect student proficiency in an indirect manner. As we explained in the Methodology section, we used the number of teachers the classes had throughout the year as turnover parameter and we analyzed our problem by estimating a multinomial logistic model.

As shown in Table 7, the marginal effects of the violence index suggest that school violence is associated with a lesser probability of groups having only one teacher and with a greater probability of having two or more teachers, although these effects were not statistically significant. However, when we replace the violence rate with the indicators that it

comprises, we find strong evidence of the association suggested by the violence index. Actually, the presence of physical assault at schools during the academic year and the presence of drug dealing and/or consumption in their premises reduce the probability of classes having just one Portuguese teacher during the academic year by approximately 38%, and increase the probability of teacher turnover by around 6.5%. These rates confirm the findings of the study conducted by UNESCO that school violence negatively affects teachers' motivation and may prompt them to leave violent schools.

Table 7: Impact of school violence on teacher turnover

Variable	# of teachers	Portuguese		Math	
		Coefficient	SE	Coefficient	SE
Violence index	0	0.00542	0.00387	0.00138	0.00371
	1	-0.06069	0.03699	-0.06991	0.04697
	2 or more	0.00830	0.00636	0.00976	0.00710
Attempt on life	0	0.01545	0.02288	0.02039	0.02549
	1	0.52264***	0.19828	-0.15252	0.21711
	2 or more	-0.09267***	0.03327	0.01793	0.03257
Theft	0	-0.01218	0.01427	-0.01061	0.01262
	1	-0.04250	0.16364	0.16374	0.18265
	2 or more	0.01073	0.02776	-0.02153	0.02757
Robbery	0	0.02169	0.03037	0.00742	0.02488
	1	0.07286	0.25852	-0.13612	0.30430
	2 or more	-0.01763	0.04375	0.01844	0.04562
Physical assault	0	-0.01045	0.00936	-0.01655*	0.00885
	1	-0.36604**	0.14608	-0.16954	0.16651
	2 or more	0.06510***	0.02479	0.03050	0.02468
Presence of weapons	0	0.01752	0.01136	0.00054	0.00961
	1	0.22753	0.16224	-0.07353	0.18079
	2 or more	-0.04351	0.02736	0.01088	0.02724
Presence of drugs	0	0.01058	0.01198	0.00924	0.01091
	1	-0.39958***	0.15084	0.07546	0.17872
	2 or more	0.06421**	0.02556	-0.01424	0.02678
Gang attacks	0	0.02143*	0.01123	0.02655**	0.01138
	1	-0.13655	0.17614	-0.28078	0.17747
	2 or more	0.01698	0.02970	0.03512	0.02650

Source: Saeb 2003.
Robust standard errors (SE).
***significant at 1% **significant at 5% *significant at 10%

Teachers' reaction to threats to their physical well-being seems natural, but their reaction to the presence of drugs at schools is surprising. Besides the deleterious effect on student learning, as pointed out in the previous section, drug dealing and/or consumption seems to strongly interfere on teachers' daily work. In fact, if students are involved in drug dealing or if they are customary drug users, they feel more powerful to coerce teachers to reduce the rigor with which they conduct their classes and to threaten them in case they do not

meet their demands. Moreover, curfews, shootouts and riots are quite common in neighborhoods ruled by drug pushers, rendering working conditions too risky.

Another school violence indicator with remarkable marginal effects concerns attempt on life, but the signs of these effects are different from those expected. At first, it seems unreasonable that the presence of this violent event at a given school will increase the probability of a group having only one teacher throughout the academic year and reduce the probability of teacher turnover, but given the severity of the episode, we can understand this result. The threat to someone's physical well-being at a given school tends to discourage attendance to that school: teachers, for example, may ask to get transferred and may not be replaced due to violent events. Therefore, there must an increase in the probability of a group not having any teacher during the academic year, as the marginal effect suggests, although it is not significant, but not in the probability of that class having several teachers throughout the year.

It should be highlighted that violence indicators only had a remarkable impact on the turnover of Portuguese teachers. Initially, we assumed the existence of a driving force acting in this direction and another force acting in favor of the turnover of Math teachers. The former is the largest relative percentage of women among Portuguese teachers, as women appear to be more sensitive to violence, as suggested by the DATASUS data on victims. The latter concerns the lack of Math teachers in the job market, which gives these teachers a greater bargaining power and eventually motivates them to change schools. Both the larger relative percentage of women among Portuguese teachers and the lack of Math teachers are supported by real-world situation, as will be outlined ahead, but apparently the first effect predominates.

As shown in Table 8, the percentage of women among Portuguese teachers exceeds 80%, whereas this rate falls to 55% among Math teachers. According to DATASUS, 93.62% of homicide victims aged 15 to 24 years, in 2003, were male. Assuming again that the characteristics of homicide victims mirror the attributes of murderers, which is perhaps a strong though plausible hypothesis, we may say that women are more sensitive to violence and, therefore, it is natural that they respond more often to violent events. In this specific case, they respond by changing schools.

Table 8: Profile of eighth grade and senior high school grade teachers at public schools

Subject	% men	% women
Portuguese	17.32	82.68
Math	44.07	55.93

Source: SAEB 2003.

The lack of Math teachers can be described as follows: if the cost in terms of diligence required from a undergraduate course in Mathematics is higher and if the salary paid to public school teachers is the same for all subjects, a rational individual is expected to choose to teach any other subject, unless his/her preferences and skills in Math are sufficiently strong. Thus, wage equality of public school teachers implies that the only variable of adjustment in this market for Math teachers refers to the quality of working conditions. That is, if this scarcity were actually present, Math teachers would have more options to move from more violent schools to less violent ones and consequently there would be a greater turnover of these teachers. As we do not have enough data on the number of Math and Portuguese teachers in the Brazilian job market, we used two indirect indicators. The first one consisted of the total number of undergraduate students about to graduate in Languages and in Mathematics in 2003 (data from *INEP-Provão*), representing a flow indicator: 34,600 versus 15,025, a difference of 130%. The second indicator consisted of the total number of candidates enrolled in the competition exams for middle and high school teachers in the state of São Paulo in 2003, representing a stock indicator: 60,631 for Portuguese versus 39,091 for Math, a difference of 55%. As, in general, the number of Portuguese and Math classes is the same in elementary schools, both indicators confirm our hypothesis of the lack of Math teachers. However, as we could already observe, the relative percentage of women among Portuguese teachers seems to predominate.

Finally, in order to check whether there is actually a relationship between school violence and a higher probability for teachers to get transferred from schools, we ran a *logit* whose dependent variable corresponds to each teacher's desire to change schools and the covariates are their own characteristics, characteristics of the groups they teach and of the schools where they work and some school violence variable.[13] The marginal effects show that the violence index is positively related to the teachers' probability to change schools. But when we replace this index with the indicators it comprises, we note that attempt on life and presence of drugs guide the result of the violence index, as shown in the table below.

[13] The descriptive statistics of the variables used in this estimation are shown in Table A3 in the Appendix.

Table 9: Impact of school violence indicators on the probability of a teacher changing schools

Variable	Coefficient	SE
Violence index	0.00823*	0.00492
Attempt on life	0.04898*	0.02793
Theft	-0.02386	0.02040
Robbery	0.05077	0.04552
Physical assault	-0.01384	0.02044
Presence of weapons	0.00515	0.02066
Presence of drugs	0.03972**	0.01931
Gang attacks	0.00817	0.02056

Source: Saeb 2003.
Robust standard errors (SE).
***significant at 1% **significant at 5% *significant at 10%

Once again, we note the effect of drug dealing and/or consumption on teachers' lack of motivation. As previously outlined, the presence of drugs at schools seems to strongly interfere with teachers' daily work routine.

5. Final remarks

More often than not, the mass media report on the occurrence of several violent events within or outside school premises. Is there any direct relationship between violence in these schools and worse student performance, controlling for characteristics of the students and of the teaching staff and for the infrastructure of these schools? Moreover, is there any indirect association between violence in these schools and student performance, which includes teachers' loss of motivation? In this study, we investigated these questions and showed that students who attended more violent schools usually had a worse performance on SAEB 2003 tests, even when the attributes of students, classes, teachers and schools were controlled for. We also found evidence that violence affects more students at the lower tail of the proficiency distribution. In addition, we found out that, besides this direct relationship between school violence and proficiency, there seems to be an indirect association between these variables that operates by means of teacher turnover. We showed that the occurrence of violent events at a school is negatively correlated with the probability of groups having only one teacher during the academic year, and positively associated with the probability of these groups having problems with teacher turnover. For all these results, one should emphasize the deleterious effect of the presence of drugs at schools: drug dealing and/or consumption seems to undermine the motivation of both students and teachers.

Nevertheless, it is important to highlight that these associations should be interpreted with caution: as we pointed out, there may be endogeneity in the association between school violence and student proficiency arising from the simultaneity of relationships between these variables and/or by the omission of relevant variables, such as parent's preference to enroll their children in less violent schools. Thus, it is necessary to consider the limitations of the results obtained in this study regarding the proposition of public policies against school violence. Bearing this in mind, we can only say that policies that try to reduce school violence, such as the *Escolas de Paz* (Schools of Peace) program in Rio de Janeiro, or the *Escola da Família* (School for the Family) program in São Paulo, might be efficient in improving the quality of teaching. Also, policies targeted at combating drug dealing may improve student learning, either due to the direct effects on the school environment or by the indirect effect through the improvement of teachers' working conditions.

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7. Appendix

7.1. Construction of school violence indicators

Part of SAEB 2003 questionnaire for school principals:

SCHOOL VIOLENCE

During this academic year, the following facts happened	External Agent (not a school member)		Internal Agent (a school member)	
	Yes	No	Yes	No
130. Attempt on teachers and/or school workers' lives within school limits	(A)	(B)	(C)	(D)
131. Attempt on students' lives within school within school limits	(A)	(B)	(C)	(D)
132. Teachers and/or school workers were victims of larceny within school limits	(A)	(B)	(C)	(D)
133. Students were victims of larceny within school limits	(A)	(B)	(C)	(D)
134. Teachers and/or school workers were victims of violent robbery within school limits	(A)	(B)	(C)	(D)
135. Students were victims of violent robbery within school limits	(A)	(B)	(C)	(D)

During this academic year the following events were or were not common	External Agent (not a school member)			Internal Agent (a school member)		
	Never	Sometimes	Always	Never	Sometimes	Always
146. Consumption of illicit drugs within school limits	(A)	(B)	(C)	(D)	(E)	(F)
147. Consumption of illicit drugs in the surroundings of the school	(A)	(B)	(C)	(D)	(E)	(F)
148. Drug dealing within school limits	(A)	(B)	(C)	(D)	(E)	(F)
149. Drug dealing in the surroundings of the school	(A)	(B)	(C)	(D)	(E)	(F)

During this academic year the following events were or were not common	Yes	No
150. School members carrying fire guns	(A)	(B)
151. School members carrying cutting weapons	(A)	(B)
152. Gangs acting within school limits	(A)	(B)
153. Gangs acting in the surroundings of the school	(A)	(B)

During this academic year there was	Student		Teacher	
	Yes	No	Yes	No
155. Physical agression toward a teacher	(A)	(B)	(C)	(D)
157. Phisical agression towards students	(A)	(B)	(C)	(D)

– Intermediate violence indicators:

– Questions 130-135: 1, if the principal answers (A) or (C)
0, if the principal answers (B) and (D)

– Questions 146-149: 1, if the principal answers (B), (C), (E) or (F)
0, if the principal answers (A) and (D)

– Questions 150-153: 1, if the principal answers (A)
0, if the principal answers (B)

– Questions 155 and 157: 1, if the principal answers (A) or (C)
0, if the principal answers (B) and (D)

We had grouped those questions because each category had few observations.

7.2. Tables

Table A1: Descriptive statistics (Proficiency) – Students

Variable	Sample	Mean	SD	Min	Max
Proficiency	48,880	248.24	49.44	97.55	455.64
Male	22,483	0.46	0.50	0.00	1.00
White	23,671	0.48	0.50	0.00	1.00
Age	48,880	16.48	2.14	12.00	22.00
Number of bathrooms	48,880	1.29	0.64	0.00	3.00
Number of rooms	48,880	2.40	0.69	0.00	3.00
Number of vehicles	48,880	0.57	0.76	0.00	4.00
Refrigerator	46,408	0.95	0.22	0.00	1.00
Washing machine	33,921	0.69	0.46	0.00	1.00
Maternal education	48,880	6.52	4.09	0.00	15.00
Repeater	17,677	0.36	0.48	0.00	1.00
Study allowance from the government	2,381	0.05	0.22	0.00	1.00
Working student	16,866	0.35	0.48	0.00	1.00
State school	40,010	0.82	0.39	0.00	1.00
Municipal school	8,603	0.18	0.38	0.00	1.00
Federal school	267	0.01	0.07	0.00	1.00
Shift: Morning	21,494	0.44	0.50	0.00	1.00
Shift: Morning/Afternoon	324	0.01	0.08	0.00	1.00
Shift: Afternoon	12,274	0.25	0.43	0.00	1.00
Shift: : Afternoon/Evening	612	0.01	0.11	0.00	1.00
Shift: Evening	14,176	0.29	0.45	0.00	1.00
8th grade of middle school	29,582	0.61	0.49	0.00	1.00
Senior grade of high school	19,298	0.39	0.49	0.00	1.00
Subject: Portuguese	24,661	0.50	0.50	0.00	1.00
Subject: Math	24,219	0.50	0.50	0.00	1.00
Teacher: different sex	23,529	0.48	0.50	0.00	1.00
Teacher: different race	20,601	0.42	0.49	0.00	1.00
Teacher: level of education	47,659	0.98	0.16	0.00	1.00
Teacher: graduate degree	22,166	0.45	0.50	0.00	1.00
Teacher: : up to 10 years' experience	17,545	0.36	0.48	0.00	1.00
Teacher: : Ln(salary)	48,880	3.59	0.53	1.79	5.95
Group: number of teachers in academic year	48,880	1.15	0.38	0.00	3.00
Group: Number of students in the classroom	48,880	27.17	8.00	1.00	58.00
Group: % men	48,880	46.25	12.67	0.00	100.00
Group: % non-whites	48,880	51.65	21.71	0.00	100.00
Group: % repeaters	48,880	37.21	20.74	0.00	100.00
Group: % students with study allowance	48,880	4.84	11.23	0.00	78.38
Group: % working students	48,880	34.80	22.48	0.00	100.00
Group: % absenteeism on the day of SAEB test	48,880	22.35	18.32	-328.57	97.56
School: Ln(principal's salary)	48,880	7.36	0.47	5.48	8.25
School: cleaning of classrooms	43,665	0.89	0.31	0.00	1.00
School: photocopier	18,773	0.38	0.49	0.00	1.00
School: number of school board meetings	48,880	2.53	0.93	0.00	3.00
School: fence or wall around school	40,417	0.83	0.38	0.00	1.00
School: average maternal education	48,880	6.40	1.86	1.33	13.90
School: % households with electric power supply	48,880	98.37	3.67	25.00	100.00

Source: Saeb 2003.

TableA1: Descriptive statistics (Proficiency) – Students (Cont'd)

Variable	Sample	Mean	SD	Min	Max
School: violence index	48,880	2.52	1.79	0.00	7.00
School: attempt on life	5,816	0.12	0.32	0.00	1.00
School: theft	26,738	0.55	0.50	0.00	1.00
School: robbery	2,230	0.05	0.21	0.00	1.00
School: physical assault	20,905	0.43	0.49	0.00	1.00
School: presence of weapons	15,089	0.31	0.46	0.00	1.00
School: presence of drugs	34,914	0.71	0.45	0.00	1.00
School: gang attacks	17,329	0.35	0.48	0.00	1.00
Rondônia	284	0.01	0.08	0.00	1.00
Acre	132	0.00	0.05	0.00	1.00
Amazonas	1,238	0.03	0.16	0.00	1.00
Roraima	137	0.00	0.05	0.00	1.00
Pará	1,196	0.02	0.15	0.00	1.00
Amapá	123	0.00	0.05	0.00	1.00
Tocantins	368	0.01	0.09	0.00	1.00
Maranhão	1,251	0.03	0.16	0.00	1.00
Piauí	641	0.01	0.11	0.00	1.00
Ceará	2,942	0.06	0.24	0.00	1.00
Rio Grande do Norte	814	0.02	0.13	0.00	1.00
Paraíba	812	0.02	0.13	0.00	1.00
Pernambuco	1,782	0.04	0.19	0.00	1.00
Alagoas	514	0.01	0.10	0.00	1.00
Sergipe	405	0.01	0.09	0.00	1.00
Bahia	2,622	0.05	0.23	0.00	1.00
Minas Gerais	6,239	0.13	0.33	0.00	1.00
Espírito Santo	978	0.02	0.14	0.00	1.00
Rio de Janeiro	3,081	0.06	0.24	0.00	1.00
São Paulo	12,342	0.25	0.43	0.00	1.00
Paraná	3,142	0.06	0.25	0.00	1.00
Santa Catarina	1,169	0.02	0.15	0.00	1.00
Rio Grande do Sul	2,889	0.06	0.24	0.00	1.00
Mato Grosso do Sul	731	0.01	0.12	0.00	1.00
Mato Grosso	937	0.02	0.14	0.00	1.00
Goiás	1,353	0.03	0.16	0.00	1.00
Distrito Federal	758	0.02	0.12	0.00	1.00
Metropolitan region	18,973	0.39	0.49	0.00	1.00
City with 200,000 inhabitants or over	4,716	0.10	0.30	0.00	1.00
City with less than 200,000 inhabitants	25,191	0.52	0.50	0.00	1.00

Source: Saeb 2003.

Table A2: Descriptive statistics (Turnover) – Groups

Variable	Sample	Mean	SD	Min	Max
Number of Portuguese teachers in the academic year: 0	63	0.02	0.15	0.00	1.00
Number of Portuguese teachers in the academic year: 1	2,267	0.84	0.37	0.00	1.00
Number of Portuguese teachers in the academic year: 2 or more	381	0.14	0.35	0.00	1.00
Number of Math teachers in the academic year: 0	60	0.02	0.15	0.00	1.00
Number of Math teachers in the academic year: 1	2,259	0.83	0.37	0.00	1.00
Number of Math teachers in the academic year: 2 or more	392	0.14	0.35	0.00	1.00
Group: number of students in the classroom	2,711	25.23	8.03	1.00	58.00
Group: % men	2,711	46.58	13.27	0.00	100.00
Group: % non-whites	2,711	53.10	21.79	0.00	100.00
Group: % repeaters	2,711	40.61	21.64	0.00	100.00
State school	2,104	0.78	0.42	0.00	1.00
Municipal school	593	0.22	0.41	0.00	1.00
Federal school	14	0.01	0.07	0.00	1.00
Shift: Morning	1,077	0.40	0.49	0.00	1.00
Shift: Morning/Afternoon	18	0.01	0.08	0.00	1.00
Shift: Afternoon	683	0.25	0.43	0.00	1.00
Shift: Afternoon/Evening	32	0.01	0.11	0.00	1.00
Shift: Evening	900	0.33	0.47	0.00	1.00
8th grade of middle school	1,771	0.65	0.48	0.00	1.00
Senior grade of high school	940	0.35	0.48	0.00	1.00
School: Ln(Principal's salary)	2,711	7.31	0.49	5.48	8.25
School: Cleaning of classrooms	2,376	0.88	0.33	0.00	1.00
School: Photocopier	1,011	0.37	0.48	0.00	1.00
School: Number of school board meetings	2,711	2.51	0.95	0.00	3.00
School: Fence or wall around school	2,221	0.82	0.38	0.00	1.00
School: Average maternal education	2,711	6.14	1.86	1.33	13.90
School: Number of household with electrical power supply	2,711	97.94	4.55	25.00	100.00
School: Violence index	2,711	2.43	1.80	0.00	7.00
School: Attempt on life	314	0.12	0.32	0.00	1.00
School: Theft	1,408	0.52	0.50	0.00	1.00
School: Robbery	117	0.04	0.20	0.00	1.00
School: Physical assault	1,161	0.43	0.49	0.00	1.00
School: Presence of weapons	830	0.31	0.46	0.00	1.00
School: Presence of drugs	1,862	0.69	0.46	0.00	1.00
School: Gang attacks	893	0.33	0.47	0.00	1.00

Source: Saeb 2003.

Table A2: Descriptive statistics (Turnover) – Groups (Cont'd)

Variable	Sample	Mean	SD	Min	Max
Rondônia	17	0.01	0.08	0.00	1.00
Acre	8	0.00	0.06	0.00	1.00
Amazonas	67	0.02	0.16	0.00	1.00
Roraima	8	0.00	0.06	0.00	1.00
Pará	72	0.03	0.16	0.00	1.00
Amapá	8	0.00	0.05	0.00	1.00
Tocantins	24	0.01	0.09	0.00	1.00
Maranhão	78	0.03	0.17	0.00	1.00
Piauí	39	0.01	0.12	0.00	1.00
Ceará	173	0.06	0.24	0.00	1.00
Rio Grande do Norte	48	0.02	0.13	0.00	1.00
Paraíba	47	0.02	0.13	0.00	1.00
Pernambuco	101	0.04	0.19	0.00	1.00
Alagoas	33	0.01	0.11	0.00	1.00
Sergipe	23	0.01	0.09	0.00	1.00
Bahia	158	0.06	0.23	0.00	1.00
Minas Gerais	342	0.13	0.33	0.00	1.00
Espírito Santo	55	0.02	0.14	0.00	1.00
Rio de Janeiro	171	0.06	0.24	0.00	1.00
São Paulo	594	0.22	0.41	0.00	1.00
Paraná	156	0.06	0.23	0.00	1.00
Santa Catarina	70	0.03	0.16	0.00	1.00
Rio Grande do Sul	199	0.07	0.26	0.00	1.00
Mato Grosso do Sul	41	0.02	0.12	0.00	1.00
Mato Grosso	58	0.02	0.15	0.00	1.00
Goiás	86	0.03	0.18	0.00	1.00
Distrito Federal	36	0.01	0.11	0.00	1.00
Metropolitan region	981	0.36	0.48	0.00	1.00
City with 200,000 inhabitants or over	257	0.09	0.29	0.00	1.00
City with less than 200,000 inhabitants	1,474	0.54	0.50	0.00	1.00

Source: Saeb 2003.

Table A3: Descriptive statistics (Turnover) – Teachers

Variable	Sample	Mean	SD	Min	Max
Teacher intends to change schools	640	0.13	0.33	0.00	1.00
Male	1,528	0.31	0.46	0.00	1.00
White	3,260	0.65	0.48	0.00	1.00
College education	4,841	0.97	0.18	0.00	1.00
Graduate degree	2,242	0.45	0.50	0.00	1.00
Up to 10 years' experience	1,856	0.37	0.48	0.00	1.00
Ln(hourly wage)	5,001	3.57	0.54	1.79	5.95
State school	3,899	0.78	0.41	0.00	1.00
Municipal school	1,076	0.22	0.41	0.00	1.00
Federal school	26	0.01	0.07	0.00	1.00
Shift: Morning	1,988	0.40	0.49	0.00	1.00
Shift: Morning/Afternoon	36	0.01	0.08	0.00	1.00
Shift: Evening	1,623	0.32	0.47	0.00	1.00
Shift: Afternoon	1,293	0.26	0.44	0.00	1.00
Shift: Afternoon/Evening	61	0.01	0.11	0.00	1.00
8th grade of elementary school	3,258	0.65	0.48	0.00	1.00
Senior grade of high school	1,743	0.35	0.48	0.00	1.00
Subject: Portuguese	2,528	0.51	0.50	0.00	1.00
Subject: Math	2,473	0.49	0.50	0.00	1.00
Group: Number of students in the classroom	5,001	25.05	8.01	1.00	58.00
Group: % men	5,001	46.55	13.26	0.00	100.00
Group: % non-whites	5,001	53.15	21.71	0.00	100.00
Group: % repeaters	5,001	40.46	21.62	0.00	100.00
School: Ln(Principal's salary)	5,001	7.31	0.49	5.48	8.25
School: Cleaning of classrooms	4,431	0.89	0.32	0.00	1.00
School: Photocopier	1,854	0.37	0.48	0.00	1.00
School: Number of school board meetings	5,001	2.51	0.95	0.00	3.00
School: Fence or wall around school	4,080	0.82	0.39	0.00	1.00
School: Average maternal education	5,001	6.16	1.86	1.33	13.90
School: number of households with electrical power supply	5,001	98.05	4.29	25.00	100.00
School: Violence index	5,001	2.42	1.80	0.00	7.00
School: Attempt on life	579	0.12	0.32	0.00	1.00
School: Theft	2,601	0.52	0.50	0.00	1.00
School: Robbery	212	0.04	0.20	0.00	1.00
School: Physical assault	2,083	0.42	0.49	0.00	1.00
School: Presence of weapons	1,524	0.30	0.46	0.00	1.00
School: Presence of drugs	3,403	0.68	0.47	0.00	1.00
School: Gang attacks	1,689	0.34	0.47	0.00	1.00

Source: Saeb 2003.

Table A3: Descriptive statistics (Turnover) – Teachers (Cont'd)

Variable	Sample	Mean	SD	Min	Max
Rondônia	34	0.01	0.08	0.00	1.00
Acre	14	0.00	0.05	0.00	1.00
Amazonas	134	0.03	0.16	0.00	1.00
Roraima	16	0.00	0.06	0.00	1.00
Pará	130	0.03	0.16	0.00	1.00
Amapá	14	0.00	0.05	0.00	1.00
Tocantins	44	0.01	0.09	0.00	1.00
Maranhão	141	0.03	0.17	0.00	1.00
Piauí	70	0.01	0.12	0.00	1.00
Ceará	331	0.07	0.25	0.00	1.00
Rio Grande do Norte	86	0.02	0.13	0.00	1.00
Paraíba	87	0.02	0.13	0.00	1.00
Pernambuco	185	0.04	0.19	0.00	1.00
Alagoas	58	0.01	0.11	0.00	1.00
Sergipe	41	0.01	0.09	0.00	1.00
Bahia	264	0.05	0.22	0.00	1.00
Minas Gerais	628	0.13	0.33	0.00	1.00
Espírito Santo	107	0.02	0.14	0.00	1.00
Rio de Janeiro	324	0.06	0.25	0.00	1.00
São Paulo	1,080	0.22	0.41	0.00	1.00
Paraná	299	0.06	0.24	0.00	1.00
Santa Catarina	137	0.03	0.16	0.00	1.00
Rio Grande do Sul	358	0.07	0.26	0.00	1.00
Mato Grosso do Sul	79	0.02	0.12	0.00	1.00
Mato Grosso	104	0.02	0.14	0.00	1.00
Goiás	140	0.03	0.16	0.00	1.00
Distrito Federal	71	0.01	0.12	0.00	1.00
Metropolitan region	1,814	0.36	0.48	0.00	1.00
City with 200,000 inhabitants or over	451	0.09	0.29	0.00	1.00
City with less than 200,000 inhabitants	2,736	0.55	0.50	0.00	1.00

Source: Saeb 2003.